IDENTIFICATION AND TRACKING OF PERSONS USING RFID-TAGGED ITEMS

BACKGROUND OF THE INVENTION

Field of the Invention

5   The present invention relates to individual identification and tracking systems and, more particularly, to a system and method for identifying and tracking persons using RFID (Radio Frequency Identification) tagged items carried on the persons.

Description of the Related Art

Manufacturers, distributers and/or retailers have a need to track their

10   products. Conventionally, a manufacturer, a distributor or a retailer attaches a Radio Frequency Identification (RFID) tag on each product to identify and track their merchandise. By the transmission and reception of radio signals to and from the RFID tag on the product, the product can be tracked from the time of manufacture to the time of sale without any direct visual or physical contact with the product being

15   monitored. RFID tag information typically stored in a RFID tag of a product includes (1) a retail SKU number (e.g., UPC - universal product code) identifying the name, manufacturer and/or suggested price of the product, (2) a unique serial number identifying the product, or (3) the SKU number and the unique serial number. In the past, the SKU numbers have been printed on products in the form of bar codes

which can be read by a Point-of-Sale (POS) terminal having a bar code scanner. A

typical use of the SKU number is to look up the product price at the time of

purchase. Merchants also use the SKU numbers to keep track of inventory so that

they know which products are selling well and when to reorder the products from

5   wholesalers. The unique serial number stored in a RFID tag can be a globally

unique number or a number assigned in series to products manufactured in the

same product category.

A typical RFID tag on a product includes an antenna and a silicon chip

containing modulation circuits, control logic and non-volatile memory. The silicon

10   chip derives electrical power from radio signals received by the antenna or from a

battery, and is able to exchange data with a RFID tag scanner by demodulating and

modulating the radio signals. The non-volatile memory of the RFID tag typically has

a storage capacity of 5 to 256 bytes. A computer coupled to the RFID tag scanner

can read and write to and from the memory of the RFID tag using radio signal

15   transmission. A detailed description of the structure and operation of a RFID tag for

a product is discussed in a co-pending application, U.S. Application No. 09/790,104

(Attorney Docket No. RSW920000178US1), filed on Feb. 21, 2001, owned by the

assignee of the present application, and entitled "Method to Address Security and

Privacy Issues of the Use of RFID Systems to Track Consumer Products", which is

20   herein fully incorporated by reference.

Due to the recent development of RFID tag technology, RFID tags can be

manufactured inexpensively and in non-conspicuous miniature sizes, so that they

can be integrated into products during the manufacturing process of the products, rather than being attached to the packaging of the products.

SUMMARY OF THE INVENTION

The present invention provides a new method and system for using RFID tagged items carried on persons to identify and track the persons. The tracking information can be used to provide targeted advertising and to improve existing store systems and tracking systems.

In one embodiment, previous purchase records of persons (e.g., customers) who shop at a store are collected by POS terminals and stored in a transaction database. When a person carrying or wearing items having RFID tags therein enters the store or other designated area, a RFID tag scanner located therein scans the RFID tags on that person and reads the RFID tag information. The RFID tag information collected from the person is correlated with transaction records stored in the transaction database to determine the exact identity of the person, or some characteristic about the person. Then, as that person moves around the store, different RFID tag scanners located throughout the store can pick up radio signals from the RFID tags carried on that person and the movement of that person is tracked based on these detections.

In another embodiment, without having any prior records of individuals and their purchase records, a person carrying RFID-tagged items can be scanned to identify a collection of items that the person is carrying. The present invention

assigns a tracking number to that person based on the collected RFID tag

information, and the tracking number is used to track the person's movement. In

this embodiment, the exact identity (i.e., name, address, etc.) is not determined, but

the person is still tracked based on their association with the collected RFID tag

5 information.

In these embodiments, the tracking information can be used to provide

targeted advertising to the person as the person roams through the store, or to

analyze and improve existing store systems, such as the physical layout of the

store, advertisement displays in the store, customer service systems in the store,

10 lighting and other environmental settings in the store system, etc.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a block diagram of a person identification system using RFID-

tagged items according to a first embodiment of the present invention.

Figure 2 is a flowchart illustrating the processing steps of a method of

15 identifying and tracking persons using RFID-tagged items according to a first

embodiment of the present invention.

Figure 3 is a block diagram of a person tracking system using RFID-tagged

items according to a second embodiment of the present invention.

Figure 4 is a flowchart illustrating the processing steps of a method of

20 tracking persons using RFID-tagged items according to a second embodiment of the

present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the drawings, the same reference numerals are used to designate the same elements.

Figure 1 is a block diagram of a person identification and tracking system 100 according to a first embodiment of the present invention. The system 100 will be explained for use in a retail store, but is equally applicable in other locations or geographical areas. As shown in Fig. 1, the system 100 includes a plurality of RFID tag scanners 20, a correlation module 10 including a person tracking unit 12, a transaction database 30, a data compiler 40, and a plurality of POS (Point-of-Sale) terminals 50, all operatively coupled.

The POS terminals 50 are located at places, such as the front area of a retail store, where individuals (e.g., customers) render payment for merchandise. When the persons make purchases at the store, the purchase records collected by the POS terminals 50 are received by the data compiler 40. The purchase records may include information on products that the person has purchased (e.g., SKU number, unique serial number, etc.) as well as the personal information of the purchaser, such as the name, address, customer number, etc. Generally, the product information will be obtained by scanning bar codes on the products, and the personal information will be obtained when the person uses his or her credit card, bank card, shopper card or the like to render payment for the purchasing products. In some embodiments, the purchased product information may be obtained by the

POS terminals 50 by detecting radio signals from RFID tags on the purchased

products at the point of sale.

The data compiler 40 associates the personal information with the products

that the person has purchased, and stores both the personal and purchased product

5   information in the transaction database 30. The data compiler 40 also updates the

personal and purchased product information stored in the transaction database 30

as the existing and new persons make new purchases.

The RFID tag scanners 20 are located throughout the "roaming" areas of the

store. A roaming area is defined herein as any area where a person can move

10   around freely. Each of the RFID tag scanners 20 is capable of scanning a

predetermined range area and reads radio signals transmitted from RFID tags

present in that range. In a preferred embodiment, RFID tags 70 are integrated into

items and such items are introduced to the system 100 by persons 60 who are

wearing or carrying such items. Any item can include a RFID tag and may be a hat,

15   watch, belt, shoes, scarf, purse, wallet, clothing, briefcase, jewelry, or any other item

that can be "carried" on or by a person. The RFID tags 70 are conventional RFID

tags that are extremely small and inconspicuous although Fig. 1 has been drawn to

exaggerate the size and location of the RFID tags 70. Depending on the

application, the RFID tag 70 may store therein a retail SKU number, a unique serial

20   number identifying the item, or both.

A collection of RFID tag information from all the RFID tags 70 carried on a

single person 60 is read by the RFID tag scanner 20 and processed by the

correlation module 10. Based on this collection of RFID tag information, the correlation module 10 identifies products on that person 60. The correlation module 10 correlates the identified product information with purchased product information stored in the transaction database 30 to determine the exact identity of the person

5   60. In another embodiment, instead of determining the exact identity of the person, some characteristics such as demographics (e.g., age, race, sex, etc.) about the person may be determined based on certain predetermined statistical information. For example, if items that are carried on the person are highly expensive name brands, e.g., Rolex watch, then the person may be classified in the upper-middle

10   class income bracket. In another example, if the items that are carried on the person are "female" items typically associated with women, e.g., a purse, scarf, pantyhose, then the gender of the person can be determined as a female.

Particularly, the correlation by the correlation module 10 may result in several outcomes depending on the information stored in the transaction database 30 and

15   the RFID tag information stored in the RFID tags 70. If the collection of RFID tag information contains unique serial numbers identifying the products carried by the person 60, the likelihood of determining the exact identity of the person 60 will be extremely high. However, if the collection of RFID tag information contains only SKU numbers, the correlation search result may indicate a plurality of individuals

20   who would qualify as a match. In such cases, other criteria may be used to narrow the group of individuals to one particular person. For instance, the person who has

the highest correlation percentage may be selected from the group of the identified persons.

When the system is configured to identify the general demographical information about the person, information such as the gender, age, social economic status, geographic location where they probably purchased the products, how long the products have been in service, etc., may be determined.

Once the exact identity or some demographics or other characteristics of the person have been determined, the person tracking unit 12 relies on this information to track the person 60 as the person 60 moves through the roaming areas. The person tracking unit 12 may assign a tracking number to each identified person and store the tracking number in association with the collection of RFID tagged product information.

As the person 60 moves through the roaming areas, different RFID tag scanners 20 located therein scan the RFID tags on the person 60. Each RFID tag scanner 20 transmits the detected RFID tag information to the person tracking unit 12 which in turn compares this information with different collections of RFID tag information to identify the tracking number or some other identification associated with the particular person to track the movement of the person. The person tracking unit 12 may keep records of different locations where the person 60 has visited as well as the visitation times in the roaming areas to track the person 60.

Once the movement of the person can be monitored based on the RFID tags carried on the person, the tracking information can be used in a number of different

ways. For example, it can be used to provide targeted advertising to the person as

the person roams. It can also be used to analyze and improve the effectiveness of

the physical layout of the roaming areas, displays in the roaming areas, customer

service areas in the roaming areas, lighting and other environmental settings in the

5   roaming areas, etc.

Fig. 2 is a flowchart illustrating the processing steps of a method of

identifying and tracking persons using RFID-tagged items according to a first

embodiment of the present invention. These processing steps can be implemented

by the system 100 of Fig. 1. As shown in Fig. 2, in Step S2, transaction records

10   (e.g., purchase history) for each person (e.g., customers at a retail store) are

collected by the POS terminals 50 and stored in the transaction database 30 by the

data compiler 40. Preferably, the transaction records are stored in association with

the personal information of each purchaser.

In Step S4, when a person carrying or wearing items having RFID tags 70 as

15   discussed above enters a scanning area of a particular RFID tag scanner 20, which

may be located in any roaming area, the RFID tag scanner 20 scans the RFID tags

on that person and reads the RFID tag information stored in the RFID tags 70. The

collected RFID tag information is correlated with the transaction records stored in

the transaction database 30 in Step S6 according to known correlation algorithms.

20   In Step S10, based on the results of the correlation and depending on the

application, the correlation module 10 determines the exact identity of the person or

some demographics or other characteristics about the person as discussed above.

Once the identify or some characteristics of the person can be determined, the person tracking unit 12 in Step S10 assigns a tracking number or some identification number to the collected RFID tag information. In Step S12, as the person moves through the roaming areas, different RFID tag scanners 20 located throughout the roaming areas scan the RFID tags carried on that person and the person tracking unit 12 tracks the movement of the person by associating the RFID tag information collected by the different scanners 20 and the tracking number.

Figure 3 is a block diagram of a tracking system 200 according to a second embodiment of the present invention. In this simple embodiment, without determining the exact identity (e.g., name and address) of the person, the person is still tracked by associating the person with information collected from RFID tags carried on the person. No purchase records of individuals are stored and used in the system 200. As shown in Fig. 3, the system 200 includes a person tracking unit 120 and a plurality of RFID tag scanners 20 that are located through roaming areas.

When a person 60 enters a retail store, a shopping mall, an airport, a train station, a train, or any location where a person can roam, a RFID tag scanner 20 located therein scans all identifiable RFID tags carried on the person 60 and obtains SKU numbers for the items carried on the person 60. This list or collection of items is then assigned to a particular tracking number or some identification number, so that this collection of items can be identified by that number. As the person 60 moves through the store or other roaming areas, different RFID tag scanners 20 located therein scan the RFID tags on the person 60, and each RFID tag scanner 20

transmits the detected RFID tag information to the person tracking unit 120. The

person tracking unit 120 compares this information with different lists of items to

identify the tracking number or the like associated with the person 60. In this

manner, the movement of the person can be tracked. The person tracking unit 120

5   may keep records of different locations where the person 60 has visited as well as

the visitation times to track the person 60.

As in the first embodiment, the tracking information collected in the second

embodiment can be used in any application where such tracking information can be

useful. For example, if the person is carrying a baby bottle, a store advertisement

10   system may be configured to advertise diapers while the person is passing a

particular display device in the store. If the person is carrying a man's wallet, the

store advertisement system may be configured to advertise razor blades and

shaving cream while the person is passing through a particular display device in the

store. Obviously, numerous examples are possible.

15   Fig. 4 is a flowchart illustrating the processing steps of a method of tracking

persons using RFID-tagged items according to a second embodiment of the present

invention. These processing steps can be implemented by the system 200 of Fig. 3.

As shown in Fig. 4, in Step S4, when a person carrying or wearing items having

RFID tags 70 enters a scanning area of a particular RFID tag scanner 20, the RFID

20   tag scanner 20 scans the RFID tags on that person and reads the RFID tag

information stored in the RFID tags 70. Then the person tracking unit 120 in Step

S20 assigns a tracking number or some identification number to the collected RFID

tag information to identify the person by this number. In Step S22, as the person moves through roaming areas, different RFID tag scanners 20 located throughout the roaming areas scan the RFID tags carried on that person and the person tracking unit 120 tracks the movement of the person by associating the RFID tag information collected by the different scanners 20 and the tracking or identification number.

Although the systems 100 and 200 of the present invention as illustrated in Figs. 1 and 3 have been described in context of a retail store, it can be applied to other locations having roaming areas, such as shopping malls, airports, train stations, bus stations, elevators, trains, airplanes, restrooms, sports arenas, libraries, theaters, museums, etc. Furthermore, the components of the system may be located at different locations without affecting the operation of the system. For example, all the components of the system 100 shown in Fig. 1 may be located at the same retail store. In the alternative, the POS terminals 50 may be located at the retail store, and the scanners 20, the correlation module 10, the transaction database 30, and/or the data compiler 40 may be installed at other locations such as airports, train stations, shopping malls, etc.

The present invention has wide applicability. For example, the present invention can be used to track and follow a particular crime suspect through public areas by tracking the identity, location and time the suspect came in contact with others. In another example, RFID tags can be incorporated into dangerous or controlled items such as firearms, drugs, medicine, explosives, etc., and appropriate

authorities can detect these RFID tags to locate and track these items.

Furthermore, the present invention can be used to improve and personalize

advertising, promotions, customer service, assistance, etc. to target each person

based on the RFID tagged items carried on the person.

5   In another embodiment, in addition to scanning RFID tags carried on a

person, the system 100 or 200 can be configured to access shopping lists, product

preferences, or any other information stored in a wireless communication device

carried by the person (e.g., a Personal Digital Assistant - PDA, a mobile phone, a

two-way pager, etc.) to augment the information collected by scanning the RFID

10   tags on the person. The augmented information can be used to further enhance the

application of the present invention. A co-pending U.S. Application No. 09/814,350

(Attorney Docket No. RSW920010015US1), filed on March 22, 2001, having a

common assignee as the present invention, and entitled "Method and System for

Providing Personalized Store-Issued Coupons Prior to Shopping," which is herein

15   fully incorporated by reference, teaches a method and system for accessing

shopping lists, product preferences and other information stored in PDAs or other

wireless communication devices using short-range wireless techniques such as

Bluetooth communication techniques or infrared communication techniques. These

techniques can be incorporated in the systems of the present invention to obtain

20   additional information about the person from the person's wireless communication

device carried by the person.

Furthermore, any information about the person's identity and/or

demographics obtained using the present invention can be used to provide more targeted advertising in public places and carriers discussed in a co-pending U.S. Application No. 09/836,963 (Attorney Docket No. RSW920010014US1), filed on April 18, 2001, having a common assignee as the present invention, and entitled

5   "Method and System for Providing Targeted Advertising in Public Places and Carriers" which is herein fully incorporated by reference.

The processing steps of the present invention and the elements in the system 100 and 200 can be implemented by computer programs in conjunction with existing hardware, or other devices such as computers, microprocessors, etc. For instance,

10   the correlation module 10 and the person tracking units 12 and 120 can be computers or microprocessors executing the correlation and tracking operations discussed above. Software programming code which embodies the present invention can be stored in storage of some type. The software programming code may be embodied on any of a variety of known media such as a diskette, or hard

15   drive, or CD-ROM, and may be distributed on such media. The techniques and methods for embodying software program code on physical media and/or distributing software code are known in the art.

The invention being thus described, it will be obvious that the same may be varied in many ways. Such variations are not to be regarded as a departure from

20   the spirit and scope of the invention, and all such modifications as would be obvious to one skilled in the art are intended to be included within the scope of the following claims.